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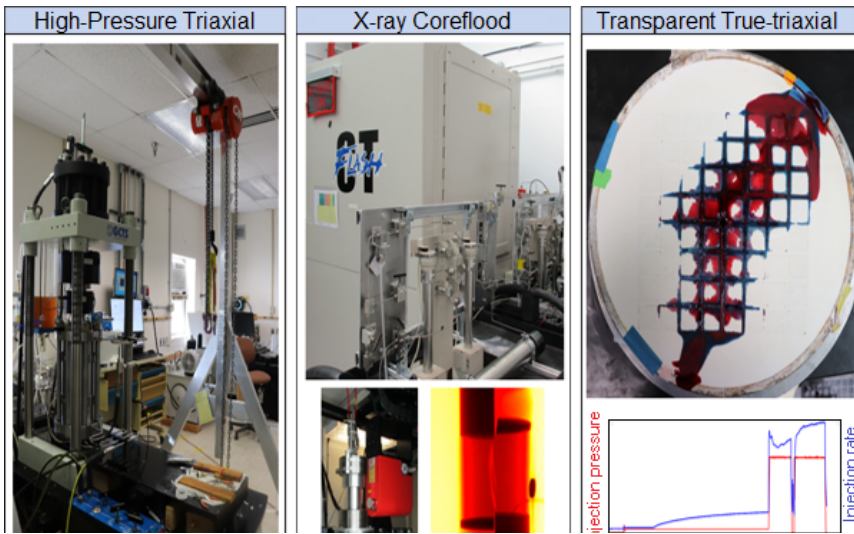
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## Tech Snapshot Earth and Environmental

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# FRACTURED EARTH LABORATORY

*Simultaneous measurements of fracture  
and fluid flow at subsurface conditions*



## SUMMARY

Researchers at Los Alamos apply extensive knowledge and expertise through the Los Alamos Fractured Earth Laboratory to measure elusive rock fracture, chemical, cementing, and flow properties with purpose-built systems that apply new and emerging measurement approaches. Unlike traditional rock mechanics laboratories, this unique laboratory capability allows researchers to accurately measure and observe fracture growth and transient flow in rock samples with microtomography at subsurface conditions. This provides critical information to solve complex and challenging subsurface fracture and flow process problems. Los Alamos is seeking to offer the Fractured Earth Laboratory's measurement capabilities and expertise to researchers and developers in the oil and gas; geothermal; and the carbon capture, sequestration, and utilization industries. By utilizing the Fractured Earth Laboratory's capabilities, researchers in these industries will have access to tools diagnose problems and develop solutions to subsurface issues.



## MARKET APPLICATION

These experimental measurements of fracture and flow properties of rock samples at high-pressures and high-temperatures provide key insights and critical data for several energy market sectors, including but not limited to: geothermal, mining, oil and gas, waste disposal, CO2 sequestration, tunnel construction, water resources, seismic risk assessment, and infrastructure. Los Alamos researchers are able to apply the full functional capabilities of the Fractured Earth Laboratory to diagnose and address Earth Science problems regarding leaks, environmental risks, inefficiencies, and inadequate performance of fracture-dominated subsurface flow systems vital to industries operating in the subsurface of the Earth.

## BENEFITS

The Los Alamos Fractured Earth Laboratory offers several benefits to multiple industries interested in solving subsurface problems:

- Provides the tools and expertise needed to measure coupled processes in the subsurface environment using 3D, real-time imaging.
- Ability to obtain data at subsurface conditions to avert the ambiguity caused by stress cycling.
- Ability to observe dynamic fracture growth

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## WHY WE ARE BUILDING FRACTURED EARTH LABORATORY

The ability to observe and understand how different rocks respond to applied stress, such as fracturing, at subsurface conditions is critically important to solving subsurface issues. Specifically, Los Alamos researchers designed and built the Fractured Earth Laboratory to study elusive and challenging cementing, rock fracture, chemistry, and flow processes for subsurface energy and waste disposal applications. This leverages extensive experience and expertise in rock mechanics, fluid flow and reactive transport in different geologic media. This unique ability to integrate, design, and perform experiments in the Fractured Earth Laboratory's advanced facility positions Los Alamos to help the Oil and Gas, Geothermal, and Carbon Capture, Sequestration, and Utilization industries solve their most challenging subsurface problems.



## WHAT'S BEHIND OUR TECHNOLOGY

The Los Alamos Fractured Earth Laboratory incorporates the latest generation of multi-sensor feedback-control technology to facilitate complex test procedures. These facilities feature fully instrumented with (1) multi-physical sensing systems that can interlink physical processes to field signals and data featuring a large high-pressure high-temperature 'quad-pore' triaxial cell, (2) an x-ray transparent triaxial coreflood apparatus, (3) a large optically transparent true-triaxial cell, and (4) a high-pressure microfluidics optical cell for accurate measurements. The Fractured Earth Laboratory also offers advanced testing of rock samples up to 250 mm in size, at high temperatures, at pressures up to 70 MPa, at an axial force up to 1 MN, with advanced pore fluid flow control. This is coupled with Los Alamos researchers' extensive expertise and experience in equipment design, test control theory, test execution, and data analysis to tackle new and emerging challenges and problems in subsurface geomechanics, hydraulics, and chemistry.



## OUR COMPETITIVE ADVANTAGES

The Fractured Earth Laboratory has the capability to characterize shear stress on natural fractures in rock attributed to the development of our triaxial direct-shear technology. These tests continuously measure fracture permeability to probe transient flow processes, with a high degree of sensitivity. Our x-ray imaging capability offers three-dimensional (3D) geometry measurements at high-stress conditions to reduce ambiguity for subsurface process observations. The Fractured Earth Laboratory capabilities can significantly reduce the time to develop, design, and conduct research to support the development of efficient, economic, and field- scalable Oil and Gas, Geothermal, and Carbon Capture, Sequestration, and Utilization technologies.



## OUR TECHNOLOGY STATUS

The Fractured Earth Laboratory is an active, service-oriented research and development laboratory that allows researchers to measure rock samples at high-pressure and high-temperature conditions. Our Fractured Earth Laboratory capabilities are well tested and have been utilized for several Oil and Gas, Geothermal, and Carbon Capture related projects. The Fractured Earth Laboratory is supported by expert trained and experienced research scientists who are eager to collaborate or conduct work on behalf of companies and universities working on challenging subsurface fracture and flow process questions.



## PUBLICATIONS AND IP

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